Abstract: Hybrid FEA/SEA Assessment for an Orthogrid Cylindrical Panel Section and Periodic Subsystem Modeling Evaluation

In the lower frequency range, where particular boundary conditions can make a significant difference to panel response characteristics Statistical Energy Analysis (SEA) has never been the analytical tool of choice. In addition to boundary condition effects, SEA is not well suited in frequency bands where no modes or less than a few modes exist. The advent of the Hybrid Module has enabled integration of Finite Element Analysis to expand and enhance the capability for response calculations within VA One into the lower frequency range. Exploration of several additional modeling approaches was completed for the cylindrical orthogrid panel test article that was examined in Reference 1. Comparison of the new analytical response predictions with the measured response data from ground test and the pure SEA results from the reference will be presented.

One approach that is considered promising is the periodic subsystem capability. Initially, a detailed FEM of just one region of the test article is defined. After evaluating this small region using symmetric boundary conditions, the FEM may be expanded to determine the properties of the entire system using similar connected regions that map over the entire test article.

Another approach is the direct use of a very detailed finite element model of the entire panel, explicitly modeling pocket and rib details of the structure.

A third approach is to approximate localized structure geometry details with a smeared property generalization using a PCOMP (NASTRAN card used to define layered composite structures) to define skin layer and ribbed layer for the orthogrid panel. The authors expect to demonstrate that the integrated Hybrid/FEM approach increases confidence in response prediction in the lower frequency range (for example from 20-300 Hz for the test article under consideration). In addition the strength and weakness of each additional approach will be highlighted and compared to those reported with those reported in an earlier paper (Reference 1).

Reference 1: "Exploring Modeling Options and Conversion of Average Response to Appropriate Vibration Envelopes for a Typical Cylindrical Vehicle Panel with Rib-stiffened Design," Presented to the Spacecraft and Launch Vehicle Workshop (SCLV), El Segundo, California, June 9, 2009.

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